

## Dragonfly Jacket: Waterproof Jacket and Climbing Pant for Female Rock Climbers

Elise Hadjis, Kevin Kissell, Kristen Morris, Jennifer Jeanerette

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Mentor Statement: This ensemble was developed as part of the student's senior-level capstone course and an extracurricular industry collaboration. The extracurricular industry partnership aimed to implement a new moisture-blocking membrane lamination technology into outdoor products. The student made the new material technology the central focus of her capstone collection to enhance the functional performance of the outerwear line. The student conducted extensive research, ideated the collection based on her chosen target market's needs, patterned, prototyped, and developed the final garments over the course of two semesters. This ensemble is one of three looks developed for the project. The student received mentorship on this project from three faculty. The first mentor supported the student's ideation, patternmaking, technical development, fitting, and aesthetic surface design development. He also provided summative design critiques throughout the entire apparel design process. The second and third mentors helped the student learn about new membrane lamination technology and advanced garment manufacturing techniques, as well as how to apply the technology in garment design to meet consumer needs. All three mentors supported the student in the final garment creation process. This ensemble was selected for submission based on the elevated level of innovation highlighting the membrane laminate technology and the student's experimentation with patternmaking and constructing waterproof garments with unique style features. The resulting design is innovative and exceeds the design features and functionality of waterproof outerwear available on the market.

**Statement of Purpose:** This ensemble focused developing a on high-performance ensemble with the functionality needed for outdoor sports, specifically rock climbing. Rock climbing is a rigorous outdoor sport that is very physically taxing and requires a wide range of motion. The climber wears a harness and is attached to a rope system, so they must wear specific clothing that fits these requirements while not interfering with their gear (Michaelson, Teel, Chattaraman 2018). When outdoor climbing, climbers are very exposed to the elements on the rock face and changes in the weather can affect them greatly. For this project, the designer specifically sought to design functional attire for female-identifying rock climbers. Females were targeted because the women's climbing market is currently growing exponentially, with more female interest in climbing (Michaelson, Teel, Chattaraman 2018). Further, the target market is otherwise active in other outdoor sports with a passion for the outdoors. She enjoys climbing, fishing, backpacking, camping, and more. She wants high performance clothing to match her lifestyle. This look is specifically designed for female climbers aged between 25-35 who live in outdoor-adjacent states, have bachelors or master's degree in fields like engineering or software development, and have a 6-figure salary with disposable income. Their favorite outdoor brands are Arcteryx, Mammut, and Norrona.



Figure 2: Design ideation

To address the functional and psychographic needs of female rock climbers, the designer explored functional textiles and manufacturing techniques.

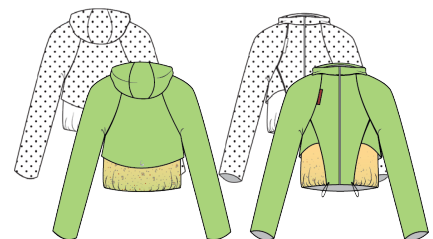


Figure 1: Technical design with membrane placement.

Most notably, the jacket features a new kind of garment waterproofing system that allowed a partial waterproof system to target area of the body that need water protection, while also providing mobility and breathability (Figure 1). The placement of the waterproof areas is a novel combination of textiles allowing air flow in higher sweat regions with waterproof rain protection in the hood, sleeves, and yoke to protect the wearer from weather. The membrane uses a patented lamination process to allow for partial membrane placement in strategic regions (U.S. Patent No. US10750805B2, 2020).



Figure 3: Ensemble being wear tested.

**Aesthetic Properties and Functional Design Features:** In this ensemble, the three garments (jacket, pant, and a long sleeve cropped top) have a modern and minimalist aesthetic that reflect current market trends in outerwear design but still represent the psychographics of the target consumer (Figure 2). The aesthetics were inspired by a fly fishing saying, “Fish don’t Exist”. This saying stems from the biological taxonomy. In the taxonomy, there is not a singular lineage for fish, they fall into many *evolutionary* families, which became a metaphor for the larger design collection. This theme was carried through this line with fish inspired patterns and color story. The textile patterns were inspired by the geometric patterns seen in trout skin, with accents of dark red inspired by the coloring of cutthroat trout.

In addition to the placed waterproof membrane of the jacket, the jacket also included several functional features including the cropped length so it can be worn over a climbing harness without interfering with any belays or hardware on the climber. A drawstring was added to waist of the jacket for further heat control by adjusting the billowing affect and air through the garment. The jacket was made from a print-ready polyester plain weave woven fabric with a dye sublimation pattern of fish skin applied. Further, the base layers in the look were designed to be functional for outdoor sports. The base layer top was made from a polyester/spandex knit that had Resistex carbon yarns woven into the fabric which provides resistance without additional weight for muscular stability. The base layer top had a compression lining made from a performance knit The pants were made from a 100% cotton double-knit with pleats at the waist to give the wearer a wide range of motion.

**Process and Execution:** The designer worked in collaboration with a series of outside companies, (Cohesive systems LLC, Artilect, and Angle Armor) to learn the lamination and manufacturing technologies, including its overall impact on design. This lamination technique utilized a vacuum table and steam iron to set the membrane and an ultra-sonic welder for waterproof seaming. This technique allowed for all the layers to be customizable in the design process. The waterproofing was done through the Cohesive 3-layer lamination process, where polyurethane membrane and lining were adhered in regions that would be exposed to weather as seen in Figure 1. The lining was finished with seam tape for a clean interior and cohesive look. Then the waterproofing was permanently set through a buck press process. The remaining garments were constructed using industrial sewing techniques common for knitwear.

**Contributions:** Overall, this garment offers many functional advantages for female rock climbers. This jacket allows them to have waterproof protection while still maximizing airflow through the garment. Functionality is top priority for outdoor climbers due to the taxing nature of the sport, and through the partial membrane lamination system, breathability and weather protection can both be achieved.

### References

- Gallagher, J.E. (2020). U.S. Patent US10750805B2. Washington, DC: U.S. Patent and Trademark Office.
- Michaelson, D., Teel, K. P., & Chattaraman, V. (2018). Assessing rock climbers' functional needs in climbing pants. *Clothing and Textiles Research Journal*, 36(4), 235–250.  
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